

Hot-Electron Superconductive Direct Detectors for Submillimeter Wavelengths

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We are developing a new type of hot-electron direct detector (HEDD) which employs a weak electron-phonon coupling in superconducting microbridges. The NEP is estimated to be of the order of 10^{-20} W/ $\sqrt{\text{Hz}}$. Such a detector will meet the needs for future background-limited detector arrays on space telescopes. The HEDD is based on a 1- μm -size transition edge sensor fabricated from an ultra-thin film of a superconductor with $T_c = 0.1\text{-}0.3$ K. The strong temperature dependence of the electron-phonon coupling in superconductors with small electron-mean-free-path allows for adjustment of the electron-phonon scattering time, and hence the bolometer response time, to the desirable value of ~ 1 ms. Measurements of the electron-phonon relaxation time in hafnium and titanium have demonstrated that a 1 ms response time at $T = 0.1$ K is possible for films fabricated on thick substrates; thus showing that a micromachined, high-thermal-resistance suspension of the detector is not needed. The radiation frequency response of prototype antenna-coupled devices has been found to be flat over the range 250-1000 GHz. We will present the results on fabrication and characterization of HEDD devices made from Ti with Nb Andreev contacts. Also, first test results of a multiplexing scheme based on an encoding technique using Hadamard Transforms will be presented. This technique should allow for reading out a large number of bolometers ($\sim 10^4$) with a single SQUID amplifier. Ultimately, HEDDs with Hadamard multiplexors will enable a compact monolithic submillimeter wave camera on a chip for astrophysical imaging applications.